Reviews and Abstracts: Vol. 1, No. 5

ANALOG COMPUTER TECHNIQUES

190:

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This is perhaps the best text on analog computation to appear so far. With this book we are a long way from the early days when the arcane art was transmitted by oral tradition and experience of working with others, and it is a pleasure to read a simple accurate presentation of the relevant facts. The book is designed for a two-semester course in analog computation, and while one could question the wisdom of devoting that much course time to the subject, nevertheless for the person who is going to make a temporary career in analog computation the book will be valuable.

The book first concentrates on the use of the machine, giving only enough facts about the hardware to make the operation sensible. Having covered the use, the author then returns to the circuits and their lack of ideal properties. This enables the user to make maximum use of the equipment when necessary. All the necessary mathematical tools are developed in the book.

Perhaps the major omission in the book is a treatment of singularities such as those that arise in computing $J_0(x)$ from its differential equation starting at $x = 0$. These problems are apt to arise in mathematical as contrasted to engineering problems. The author also does not mention the possibilities of having the machine automatically rescale itself at selected stages in a problem—a sort of floating point mode of operation.

Another minor objection is that the author, like most analog machine enthusiasts, stresses the differences between analog and digital equipment in order to claim every possible advantage, rather than stressing the similarities. But the analog field has been on the defensive for some time, and it is excusable.

R. W. Hamming, Murray Hill, N. J.

191:

Tizard, R. H. **Conversion between analogue and digital measures.** *Comput. J.* **3,** 1 (April 1960), 51–59.

The author describes the principal means of conversion of data between the digital and analogue forms. Confining himself to a small number of examples which illustrate the principal means for this conversion, the author gives a clear description of the principles involved. A comprehensive bibliography on the subject is appended.

Arthur Wouk, Waltham, Mass.

192:

Carteron, J. **Calculation analogique ou calcul numerique? conflit ou harmonie?** (Analog or digital computation? conflict or harmony?), *Chiffres* **2,** 4 (December 1959), 239–247. (French)

The author, Chief of a Mathematical Studies and Applications Section in the French electrical power system, drawing on his experience with both analog and digital methods, renders plausible the utility of both. The paper is expository in nature, and makes its comparison between digital calculations performed on machines of the IBM 650 class, and analog calculations performed on network analyzers. *Reviewer's Note*: It would be very interesting to attempt to draw similar, or opposite conclusions, when modern digital equipment with microsecond operation times are considered; to the reviewer's knowledge, this has not been done. *Arthur Wouk*, Waltham, Mass.

193:

Desoer, C. A. **The bang-bang servo problem treated by variational techniques.** *Information and Control* **2,** 4 (December 1959), 333–348.

This paper describes the use of variational calculus techniques to determine the forcing function which returns a system, subjected to an arbitrary initial displacement, to its equilibrium position in the shortest possible time. Magnitudes of the components of the forcing function vector $f(t)$ are assumed limited to be less than preassigned constants, and the system is assumed to be governed by the equation $\dot{y} = Ay + f(t)$, with A being a real constant matrix with distinct eigenvalues which have nonpositive real parts. *Norman R. Scott*, Ann Arbor, Mich

BUSINESS DATA PROCESSING

194:

Bappert, Joseph F. **Sound move toward tax equity.** *Systems* **24,** 2 (March-April 1960), 24–25.

The application of a UNIVAC 120 Punched Card Computer to mass reappraisal of real estate parcels is described. Mass reappraisal is based on weighted evaluation of field survey data including observed changes in building type, dimensions, material, structure, accessory buildings, etc. New procedure permits 8 employees to process 680 parcels daily. Former manual methods required 23 persons.

George J. Feeney, New York, N. Y.

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George J. Feeney, New York, N. Y.

195:

Computer runs savings operation. *Auditgram* **36,** 6 (June 1960), 4–7.

It is a well-known fact that only in recent years have banks given serious consideration to scientific management and cost reduction. The subject of this article is certainly timely at a time when banks are busily engaged in taking their services to their customers through the opening of "neighborhood" offices. As the author points out, the Monte Carlo method has long been accepted in solving many types of problems, and most certainly can be used advantageously by banks. Although this application represents a significant break-through in respect to many bank problems, it certainly cannot be looked upon as a simple and complete solution to all problems. In order to apply this method, many facts and statistics must be compiled and the solution can certainly be no more accurate than are the basic facts.

Edward L. Baity, Winston-Salem, N. C.

196:

Kennedy, Leon G., Jr. **Banking records that "pop up".** *Systems* **24,** 2 (March-April 1960), 11–12.

While the subject of central files for banks has always been a controversial one, it does appear that the author has probably found the best solution to the maintenance of such a file. He describes the system adequately and certainly shows how it has improved tremendously his former operation.

Edward L. Baity, Winston-Salem, N. C.

197:

Thompson, T. R. **Problems of auditing computing data: internal audit practice and external audit theory, section 1: internal audit.** *Comput. J.* **3,** 1 (April 1960), 10–11.

In the main, this paper appears to be very well written; however, I do disagree with a few points. The author states that if it is convenient, the auditor should be consulted prior to writing a program. I believe that he should always be consulted at this point regardless of convenience. In connection with the detection of fraud, it should be pointed out that in many instances the use of a computer will provide better "audit-trails" than will a manual system. I question the auditor's ability to detect modifications of a program except where such a modification results in materially altering the finished product, and in these cases the auditor should be consulted beforehand.

Edward L. Baity, Winston-Salem, N. C.

198:

De Paula, F. Clive. **Problems of auditing computing data: internal audit practice and external audit theory, section 2: the external auditor and computers.** *Comput. J.*, **3,** 1 (April 1960), 11–14.

While the author discusses many pertinent points to be considered in regard to external auditors, compliance with his program would appear to be extremely costly to the client. The use of "Auditor's Test Runs" carried out on his own program seems to be by far the strongest point in the paper. The controls which the author suggests in connection with operating programs seem extremely impractical from the standpoint of an efficient operation. Certainly, in most instances, the processing of data by an incorrect program will be very obvious and probably result in machine stoppage.

Edward L. Baity, Winston-Salem, N. C.

199:

From punched cards to computer—a practical approach. *Data Processing* **2,** 2 (April-June, 1960), 122–128.

Morgan Crucible Co. of London, England installed an I.C.T. 1201 Computer in October 1958. The I.C.T. 1201 is a drum-type machine with punched card input and punched card and printer output. Morgan, having had tabulating equipment for a number of years, used the new computer to increase the speed and flexibility of data systems operating on tabulating. The article describes two applications—preparation of production progress reports for the carbon brush department, and accumulating data for the incentive payroll system. The article also describes a new system in the planning stage—a production control scheme for factory operations. It is frankly admitted that financial savings to date have been marginal but the experience gained has been considerable with no disruption to the organization. The article should be of great interest to those contemplating transition from tabulating to computers.

Thomas H. New, East Pittsburgh, Pa.

200:

ORION, Ferranti's new time-shared data processing system. *Data Processing* **2,** 2 (April-June 1960), 114–121.

Among the most important achievements in digital computer systems design in the last five years is undoubtedly the practical attainment of the concepts of time-sharing. In describing the new Ferranti ORION system to the layman, the article under review stresses in particular possible applications of time-sharing techniques in data processing and business applications. From the brief descriptions given of the machine specification and of its proposed field of application, it would appear that ORION is similar in concept to a number of other British, French and American systems that have recently appeared on the market. It is, however, rather smaller, slower, and cheaper than its contemporaries. Thus, for a price of from three hundred thousand to one million dollars, the purchaser may obtain a time-sharing system controlled from a semi-permanent master routine (not accessible to the programmer) with a twelve microsecond ferrite core store of from four to sixteen thousand locations, average arithmetic speeds of order fifty microseconds for a two- or three-address instruction addition of two forty-eight bit operands, with multiplication times of from sixty-four to two

hundred microseconds, and with division times of from two hundred and fifty to one thousand four hundred microseconds. Magnetic-drums are available for backing storage and the whole gamut of peripheral equipment may also be supplied, facilities existing, for example, for the connection of up to thirty-two magnetic tape decks with speeds of up to ninety thousand characters per second. The system is still under development, with three computers scheduled for delivery before the end of 1961.

M. Lehman, Tel Aviv, Israel

201:

National survey of computer department salaries. *Management and Business Automation* **3** (June 1960), 20–25, 52.

A managment consulting firm surveyed 489 companies in 33 industrial categories located in 78 cities in 22 states and covering 7,000 employees. Weekly salary data was gathered on 35 types of computer and data processing jobs. The data tabulated includes: the lowest, the first quartile, the median, the average, the third quartile, and the highest. Job descriptions for the major positions covered are provided in the article. A preliminary breakdown in the types of applications the personnel worked on is also included. The installations surveyed seemed to emphasize large-scale IBM installations, with 24 705's, three 709's, and one 7070 included. Only 74 650 installations were in cluded in the survey. *Ned Chapin*, Menlo Park, Calif.

202:

CHRISTIAN, WILLIAM, **Myths of the "electronic brain."** *Management and Business Automation* **3** (June 1960), 26–28, 46–48.

This article presents a survey of some of the opinions of people in the computer field about the thinking ability of computers. The persons quoted are: John von Neumann; M. O. Kappler; Norbert Wiener; John Diebold; John W. Carr, III; Mortimer Taube; Peter H. Greene; Heinz von Foerster; Herbert L. Gelernter; and A. Newell.

Ned Chapin, Menlo Park, Calif.

203:

ANDERSON, RAGNARE E. **Computer programmers are where you find them.** *Data Processing* **2** (May-April, 1960), 15–16.

The SPAN installation in Hartford, Connecticut, was organized by four insurance companies in 1956. They recruited all of their programing personnel from among the member companies. The screening process consisted of aptitude tests, orientation tests, past record analyses, and perosnal interviews. "Concentration ability" was stressed as a major selection criterion. In placing the personnel selected, attention was given to providing fringe benefits.

Ned Chapin, Menlo Park, Calif.

204:

OXLEY, GERALDINE M. **Woman's role in data processing.** *Data Processing* **2** (April-May 1960), 19–21.

The New York Life Insurance Company in New York City has had 9 women on its data processing staff of 33. The experience with the women employed as programmers and systems analysts has been satisfactory, and some have been promoted in grade to senior programmers, senior systems analysts, and even supervisors. The women employees received the same training and screening for the job that the male employees received. Creative ability, the ability to think clearly and logically, and the talent for using ingenuity in solving complex problems apparently were stressed in selection. *Ned Chapin*, Menlo Park, Calif.

205:

HAMILTON, HAROLD B. **Univac utility unlimited.** *Systems* **24,** 2 (March-April 1960), 8–9.

The author briefly reviews G.E.'s five years of computer experience at Appliance Park. The applications discussed include payroll, material control, sales analysis, and distribution research. A major difficulty in the operation of the Computer Center, as originally constituted, was the procuring of the documents from which the computer input is prepared on time and in proper form. This resulted in the creation of a Procedures and Systems section in each operating department. These sections were made responsible for designing, writing, and debugging the applications for their departments and, on a day-to-day basis, for the production of computer input media. A production control program produced under this decentralized scheme by the Home Laundry department is discussed.

Carl H. Pollmar, Ann Arbor, Mich.

COMPUTERS AND EDUCATION

206:

• ALT, F. (editor). **Advances in computers, Volume 1,** Academic Press, 1960, 10 + 316 pps. $10.00.

This is the first volume of a new series intended to occupy a place between technical journal articles and handbooks or monographs, and would appear to fill a gap in a rapidly changing field. This volume has articles by C. C. Gotlieb on "General-Purpose Programming for Business Applications"; one by N. A. Phillips on "Numerical Weather Prediction"; one by Yehoshua Bar-Hillel on "The Present Status of Automatic Translation of Languages"; one by A. L. Samuel on "Programming Computers to Play Games"; one by R. Fatechand on "Machine Recognition of Spoken Words"; and one by G. W. Reitwiesner on "Binary Arithmetic."

Except for the last one, they are easily read by the nonexpert, and are quite interesting, up to date, and authoritative. Bar-Hillel lets his prejudices show in his article, and while this reviewer happens to agree, many people will not like some of his opinions. Samuel's article is also very interesting and stimulating. The other articles are naturally less controversial, although there is room for opinion in the weather prediction problem.

All of the articles have excellent bibliographies and, if the series continues as well as it started, they should be a significant contribution to the field.

R. W. Hamming, Murray Hill, N. J.

207:

HOLSTROM, J. E. **The multilingual terminology project.** *Bull. Provisional Internat. Comput. Center* (Rome) **No. 8** (January 1960), 11–16.

In essence, this article is a status report on the multilingual terminology project on information processing for the Provisional International Computation Center. The author emphasizes the need for preciseness between definitions in different languages for the same expression. Imperfections (vagueness, ambiguity, omissions) between languages result from the fact that a language is spontaneous growth and can be regulated only to a limited extent. As a remedy for this situation, he briefly describes the procedure for the development of a multilingual dictionary as applied to a specific subject field. The author, an engineer and a specialist in multilingual lexicography, was commissioned to organize collaboration among computer experts to produce a sample of such a dictionary. As a result, the "Incomplete Provisional Draft" of the proposed Multilingual Terminology of information processing in English, French, German, Spanish and Russian was mimeographed and distributed for discussion by those interested parties attending the International Conference on Information Processing in Paris, June 1959. The article discusses the quality and extent of the "Incomplete Provisional Draft," the acceptance of it as a sample of a feasible endeavor, and the steps leading up to the preparation of a "Second Provisional Draft" to be issued in the summer of 1960. Mention is made of a final edition of the PICC Multilingual Terminology to be completed and properly published sometime in 1961.

Marvin Howard, Canoga Park, Calif.

DIGITAL COMPUTER PROGRAMMING

208:

CODD, E. F. **Multiprogram scheduling.** *Comm. ACM* **3,** 6 (June 1960), 347–350.

A framework is developed for a systematic treatment of the scheduling of a multi-program computer. The fundamental considerations affecting the scheduling are shown to be: 1. The fraction of the memory (and other equipment) required by each program—the *space-fraction.* 2. The fraction of the available time required by each—the *time-fraction.* Graphical methods of representing the combinations of programs are presented. The concepts of *profitable mixes* of programs, of *infeasible subsets* of programs, of *target loadings*, and *load and limit vectors* are presented. Parts 3 and 4 of the paper will present a scheduling algorithm which tends to minimize the time required for executing the pending workload, subject to external constraints such as precedence, urgency, etc.

Daniel D. McCracken, Ossining, N. Y.

209:

PATRICK, ROBERT L. **A customizable computer.** *Datamation* **6,** 3 (May/June 1960), 44–45.

Each computer has an order list which is permanently wired in the hardware of the machine. Different computers have different order lists and a problem programmed for one computer will not run on another computer. The author's suggestion to alleviate the reprogramming problem is to build a computer which would have only a micro-order list wired. Between the final order list and the micro-order list would be inserted a plate which would be used by the machine to give the micro instructions which it would follow for each instruction on the order list. Then, by changing the board, the final order list could be changed. A user could order a number of different plates and thereby perform various problems more efficiently. There could be, for example, one plate for matrix operations and a completely different one for business data processing. The author describes this concept (which is not new and, in fact, has probably occurred to anyone who has given any thought to the possibilities of micro-programming) but does not develop the economic or technical feasibility.

Daniel Teichroew, Stanford, Calif.

210:

BROWN, RICHARD M. **Decoding combinations of the first n integers taken k at a time.** *Comm. ACM* **3,** 4 (April 1960), 235–236.

This article describes an algorithm for forming a dense set from the set composed of sequences of k *different* integers selected from the first n integers. The algorithm is suitable for electronic computers and is useful in naming and ordering the elements of this kind of set.

John C. McPherson, New York, N. Y.

211:

PATRICK, ROBERT L. **A start at automatic storage assignment.** *Comm. ACM* **3,** 5 (May 1960), 321–322.

An editing technique is presented for reordering a sequence of functional evaluations into a logically computable sequence if such a sequence exists. Evaluations are ordered according to the availability of the variables and the duration of the need of a variable can consequently be checked. The technique would also permit identification of unrelated functions for possible parallel evaluation and of no-longer-needed variables for reassignment of their use of storage. *Thomas A. Keenan*, Rochester, N. Y.

212:

PALL, GORDON; and SEIDEN, ESTHER. **A problem in Abelian groups, with application to the transposition of a matrix on an electronic computer.** *Math. Comput.* **14,** 70 (April 1960), 189–192.

Applied mathematics and numerical analysis have made substantial contributions to the solution of physical problems on computers. This paper is an excellent example of the potential that pure mathematics might have for developing and improving programming techniques.

In the case at hand, number theory principles are involved to find better methods for transposing a rectangular matrix, utilizing little additional memory. Impressive results are presented comparing this procedure with that of an existing SHARE program. The implementation of the method requires a set of numbers which are a function of the dimension of the matrix. While the authors feel such a set should be constructed by hand, it would probably be more useful to have a computer program available to perform this task.

A similar approach has been reported in the *Journal of ACM* **5,** 4, p. 383, "A Method for Transposing a Matrix" by Martin F. Berman, and should be compared.

Werner L. Frank, Los Angeles, Calif.

DIGITAL COMPUTER PROGRAMMING (LANGUAGES)

213:

GREEN, JULIEN. **Symbol manipulation in XTRAN.** *Comm. ACM* **3,** 4 (April 1960), 213–214.

The symbol manipulation language incorporated in the XTRAN processor is described. The description is in the form of tables and includes the definition of a "string", string expressions, and string procedures. These functions and procedures require that symbols be treated as integers.

James H. Brown, Norristown, Pa.

214:

PERLIS, A. J.; AND THORNTON, CHARLES. **Symbol manipulation by threaded lists.** *Comm. ACM* **3,** 4 (April 1960), 195–204.

Perlis and Thornton describe a list processing language which serves as a cornerstone for building up hierarchies of programs defining quite complex symbol manipulating functions. An integrated set of examples is provided after the language is defined. Included are elementary functions, such as "copy a list," and deeper functions, such as "differentiate a rational function." The "threaded list" and corresponding primitive sequencing operations to exploit this structural feature distinguish this system from other one-way list processing languages. "The essential innovation of threaded lists is the addition of threads from the end of each sublist of a list, to the next word on the list. This allows a simple, efficient method of sequencing to be carried out on a list, which will arrive at each element of every sublist, without the use of the usual pushdown lists."

The system was in a development stage at the time the paper was written. The program examples, therefore, have not benefited from machine testing. One should not enter lightly into attempting to follow them in detail. However, there is enough redundancy in the descriptive material to resolve most of the errors so that such an effort can be rewarding.

J. C. Shaw, Santa Monica, Calif.

215:

PATTERSON, G. W. **What is a code?** *Comm. ACM* **3,** 5 (May 1960), 315–318.

This "Standards" article covers the definition and use of the term "code" with emphasis on the communications and data processing sense. A code in this area requires a singular transformation from source language to code language and a unique inverse process. Reference is made to the linguistic properties of codes and the work done to formalize the concatenation algebra. Noting that most codes are single character representations, one finds codes with more or less potential character representations than the source alphabet. Examples given included the Baudot 5-bit code using letters-figures shift, and codes using extra bits for redundancy checking. The author closed with a reference to the need for extension of the codes to include control function information in addition to text.

Rudolph Habermann, Jr., Washington, D. C.

216:

SWIFT, CHARLES J. **Compiling connectives.** *Comm. ACM* **3,** 6 (June 1960), 345–346.

The author states: "The connectives 'and', 'or' and their alternatives can be used to connect words, phrases or clauses in natural English. . . the authors attempted to include as many of these uses as possible while still retaining simple rules as to what was allowable." In the second paragraph the author misidentifies as an adjectival phrase a substantive phrase which is used as a direct object in his example. One may conclude that English is not "natural." Any statement not reducible by the two scans described in the paper is illegal. In the reviewer's opinion, the description of the two scans is anything but a simple rule for allowable statements, especially for the novice.

Robert Graham, Ann Arbor, Mich.

217:

PAGES, ROBERT. **L'analyse codée, technique documentaire en psychologie sociale et en sciences humaines—présentation et resumé de la grammaire** (Coded analysis, documentary technique in social psychology and human sciences—presentation and summary of the grammar). *Chiffres* **2,** 2 (June 1959), 103–122. (French)

The grammar of coded analysis, summarized here, indicates the method of construction of a vocabulary of artificial words, the handling of a series of mathematical relationships and the systematic abbreviated use of "proper names." This technique allows the incorporation in the same process of both conceptual analysis and a wide range of types of classification. (*Author's summary*)

John G. Herriot, Stanford, Calif.

218:

SMITH, JOSEPH W. **Syntactic and semantic augments to ALGOL.** *Comm. ACM* **3,** 4 (April 1960), 211–213.

This paper proposes a set of extensions to ALGOL which will facilitate string manipulation, but which the author admits are not new. Arithmetic, assignment, and relational expressions are defined, and a means of handling substrings is given. The paper begins and ends with a few remarks on the design of languages.

Jean E. Sammet, Needham, Mass.

219:

SAMELSON, K.; AND BAUER, F. L. **Sequential formula translation.** *Comm. ACM* **3,** 2 (February 1960), 76–83.

This article is a description of techniques for translation of algorithms into machine code. The problem of translating algebraic substitution statements is very adequately described. The concept of a push-down list or "symbols' cellar" is described and shown to be a very useful mechanism for achieving a good scanner. Also described are techniques for handling, **if, for, procedure,** and other statements in the language once the translator has recognized the fact that it has such a statement under consideration. Nothing is said about constructing an efficient scanner which is capable of recognizing the type statement being worked on and then performing the translation. The problem of recursive address calculation to improve the object program using subscripted variables is well discussed, shedding much light on difficulties encountered. The reviewer would like to take issue with the authors on one point. On page 78 in the last paragraph of section 3, the statement is made that since the associative laws are not valid in floating point arithmetic the choice of sequence should be up to the programming mathematician. This is certainly true if the programmer is concerned with problems of this type. Many programmers, however, are working on problems where this causes no difficulty and the translator should be designed to produce as efficient a program as possible, consistent with the programmer's wishes.

Fred R. Dornheim, Harvey, Ill.

220:

MCILROY, M. DOUGLAS. **Macro instruction extensions of compiler languages.** *Comm. ACM* **3,** 4 (April 1960), 214–220.

This paper describes a form for defining new operations in terms of a basic assembly-like language and other defined operations. The use of such macro-instructions provides a concise way of describing complicated procedures. The author describes and illustrates with examples the important features of these definitions such as (1) the ability to refer to other definitions, (2) the indication of a reference hierarchy by parentheses, (3) the ability to conditionally include or exclude instructions, and (4) the ability to create floating addresses. An application of these techniques to writing algebraic compilers is briefly indicated. This application deals only with fully parenthesized expressions and it is not clear how remote symbolic references (floating addresses) within definitions are handled.

It is interesting to this reviewer to observe the gradual coalition of the structure of macro-assemblers (or compilers) and algebraic compilers. The author's description of the coding that must be added to a programming routine to make it a macro-instruction compiler also constitutes a description of the essential portion of an algebraic compiler. This similarity suggests that an alternate approach might be to start instead with a base program which contains a syntactical scanner, a storage allocation procedure, and a mechanism for handling remote connections.

Bruce W. Arden, Ann Arbor, Mich.

221:

BARRETT, JUNE A.; AND GREMS, MANDALAY. **Abbreviating words systematically.** *Comm. ACM* **3,** 5 (May 1960), 323–324.

This paper proposes a set of rules for forming abbreviations of words and phrases which it is claimed may be readily programmed for machine operation, while retaining mnemonic and consistent abbreviations which can also be hand produced. The number of letters to be used in the abbreviations is considered a parameter, the rules being formulated for 2-, 3-, 4-, 5-, and 6-letter abbreviations. Examples are given of the application of these rules to both single words and phrases.

Frank Engel, Jr., Pittsburgh, Pa.

DIGITAL COMPUTER SYSTEMS

222:

Operation of a flight test data handling system. *Datamation* **6,** 3 (May-June 1960), 47–48.

A system for the acquisition, digitalization, editing and digital computer input tape preparation is described. The system was developed jointly by the Datalab Division of Consolidated Electrodynamics Corporation and Douglas Aircraft Company. It consists of three separate but integrated groups of equipment: (1) airborne data acquisition equipment, (2) ground control and record station, and (3) computer input facility. The data acquisition equipment can take 100 channels of data at 500 samples per second, or can be subcommutated to take 10,000 inputs at 5 samples per second. One hundred channels may be displayed on cathode-ray tube bar plots. The analog signals are commuted to eleven-bit digital form in 18 microseconds. Output is to telemeter transmitter and/or an airborne tape recorder. The ground control and record station receives signals from the airborne vehicle. Bar charts may be made of 100 channels. Digital display of elapsed time and time

plots of 20 channels are provided. A tape is made of the data similar to the one made in the airborne facility. The computer input facility edits and selects channels for preparation of digital computer input tape from each of the two tapes mentioned above. Tape equipment enables an operator to find the tape segment corresponding to a given event at a search speed of 100 inches per second. Data are then edited by time, channel, or frame.

D. J. Campbell, Cincinnati, Ohio

223:

THORNLEY, J. M. **Which computer?** *Auto. Data Processing* **2,** 5 (May 1960), 23–27.

This article condenses the many considerations involved in selecting an electronic data processing system into a systematic presentation of essentials. While the exact content of a list of "essentials" in this activity is a matter of controversy, few will argue with most of the items listed by the author. However, the author adds some "words of wisdom" concerning the acquisition of new systems, which would lead to the end of rapid improvement in cost and performance, if taken seriously. The principal merit of the article lies in its collection of "essentials" for equipment evaluation, rather than in its new ideas.

Herbert F. Mitchell, Jr., New York, N. Y.

224:

PORT, J. R. **Computer with building block design.** *Systems* **24,** 2 (March-April 1960), 15–16.

This article is primarily a testimonial to the virtues of switching from a tab system to electronics. A brief case history, with unfortunately no numbers, of the experience of installing a UNIVAC File Computer, Model I to replace and/or augment a punched card system is presented.

George Eisler, Los Angeles, Calif.

225:

BENES, JIRI. **Electronic computing in Czechoslovakia.** *Bull. Provisional Internat. Comput. Center* (Rome) **No. 8** (January 1960), 22–26.

In this paper, the author surveys a number of aspects of electronic computing in Czechoslovakia. Six special-purpose computers are mentioned. These include an electromechanical differential analyzer, an automatic relay computer, a machine for solving partial differential equations, and a machine for the semi-automatic solution of linear programming problems. Research connected with automatic computers is carried out at the Research Institute of Mathematical Machines in Prague, and through the Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences. Preparatory work is underway for producing the digital computer EPOS, which is presumed to have a speed of 16,000 operations per second, and is intended for scientific and technical computation, for the treatment of administrative data, and for direct control of manufacture and technological processes. A URAL was imported in 1958 to provide experience in electronic computers. A few examples of applications of digital computing are given: problems of elasticity and mechanics, computing of optimum conditions of control systems with monotonic unit-step response, and the solution of certain automatic control problems of big boilers by the use of analog machines. No examples are given of the use of computers for administrative work or for the direct control of technological processes, although the latter topic is mentioned several times.

Daniel Teichroew, Stanford, Calif.

226:

GUNTSCH, FRITZ-RUDOLPH; AND LUKAS, HAROLD. **Magnet bandrechner der Technische Universität Berlin** (Magnetic-tape controlled computer of the University of Berlin). *Elektronische Datenverarbeitung* **2,** 14–46. (German)

This paper describes a small magnetic-tape controlled computer, at the Technical University of Berlin, having ferrite-core storage for 64 words, each of 25 bits, and magnetic-tape for storing the program. All timing and control functions are derived from information on the tape. Hence tape speed determines machine speed. A repetition rate of 50 kc gives word time of ½ ms. Addition and subtraction require 1 word time, multiplication 36, and division 110. The system uses about 200 tubes, 600 germanium diodes, and 2000 ferrite cores. A complete description of the command list is presented, together with example programs. The second part of the paper describes the electronic circuitry (static, vacuum-tube, packages made by Zuse), the logical circuitry (serial, binary), and the core selection system (coincident-current, with 3:1 selection ratio).

Norman R. Scoit, Ann Arbor, Mich.

227:

NEAL, W. R. **Interval estimation of the time in one state to total time ratio in a double exponential process.** *Commun. ACM* **3,** 6 (June 1960), 361–366.

It is difficult to determine the readership the author had in mind. Engineers interested in up-time ratio should be cautioned that the author has not established that "the break down, repair, and subsequent return to service of electronic computing systems is [an empirical example] of the abstract Double Exponential Process". They should be reminded that $1/\alpha$ and $1/\beta$ are usually called "mean time to repair" and "mean time between failures". On the one hand, mathematicians do not require the elaborate exposition that appears in standard textbooks as a pedagogical device to introduce more complicated distributions, while on the other hand only a mathematician could appreciate the appeal to moment generating functions to arrive at a well-known result for the Poisson distribution of multiple events. The exposition contains several notational difficulties: $f(u_i)$ is not the same function as $f(U)$, nor $g(v_i)$ the same as $g(V)$, [misprinted as $g(v)$], and P, p and $\hat{p}$ are used ambiguously. One hopes the tables in

the appendices were proof-read better than the text, which also should read 1 instead of ∞ in the upper limit of the integral defining $B(n, n)$. The article does not present the algorithm used to compute these tables. As tables of the incomplete Beta function are readily available (*Handbook of Probability and Statistics With Tables* by Burington and May, Handbook Publishers, or *Biometrika Tables for Statisticians* by Pearson, Cambridge University Press), the author has provided a tool for the elimination of the final substitution in the solution of this problem.

Monroe R. Weinstein, Paramus, N. J.

HISTORY OF SCIENCE

228:

• Needham, J.; and Ling, Wang. **Science and civilization in China, Vol. III,** Cambridge University Press, 1959, 47 + 874 pps., $27.50.

In recent years scientists have become increasingly interested in the history of science in general, and in their own special branch in particular. Thus, they have been making a strong effort to close the gap between the two cultures described by C. P. Snow. Needham's magnificent seven-volume work is a monumental effort to rectify the typical Western view that all, or almost all, of science began in Europe, and was developed there too. Actually, almost everyone is aware that the three great inventions mentioned by Bacon in his *Novum Organum*—printing, gunpowder, and the magnet—as having a profound effect on the world, did not have their origins in Europe. Needham is perhaps the first Western scientist of modern times to examine the whole of the Chinese contribution to scientific knowledge. As he points out, a literary scholar is apt to confuse fermentation and distillation when making a translation, and yet the difference is of great importance in the history of technology.

In the projected seven-volume series, Vol. I covers *Introductory Orientations*, while Vol. II has a general *History of Scientific Thought*. Vol. III, under review, covers the special fields of *Mathematics and the Sciences of the Heavens and the Earth* (mathematics, astronomy, geography and cartography, seismology, and mineralogy). As Needham writes in a note: "The purpose of this volume is to elucidate the contributions of traditional Chinese civilization to mathematics and to the sciences of the heavens and the earth—astronomy and meteorology above, geography and geology below. The facts which have been here assembled may at first sight seem a little bewildering, but one must remember that they concern the culture of more than one-fifth of the human race, a people inhibiting for three millennia a land at least as large as Europe, and certainly no less gifted than others."

Without trying to go into details, let me give just a few of the high spots I noted while reading this beautiful volume. The Chinese had a positional notation for numbers around the -2 to -1 century, a zero by 1247, $\pi = \sqrt{10} = 3.1622$ by 130 A.D. and $\pi = 3.14159$ around 250 A.D. (Ptolemy, c. 150 used 3.141666), and various progressions by the 5th, Horner's method by 13th century, and Pascal's triangle in 1303. Many other items could be cited such as congruences, the Pythagorean Theorem, but I leave them to whet the reader's appetite.

It is the same in the other fields. Often the Chinese knew and were using things before the Europeans, especially in the fields of seismology and the early use of reasonable coordinates in astronomy.

The authors are careful not to overrate the Chinese, but as a result sometimes seem to claim too little. They face up to the many related problems such as the transmission, or possible transmission, of ideas (remember, Marco Polo visited China in the 13th century), and why, if the Chinese often led the Europeans, did they not usher in the modern world? Their answer seems to be that the social and physical background of the respective civilizations made the difference.

This reviewer, having read the first three volumes, can safely say his ideas about the history of science have been permanently changed. The effect of the next four volumes can only be guessed at. It would seem that no scientist who cares about the history of his field can afford to remain ignorant of the work of Needham and Ling.

R. W. Hamming, Murray Hill, N. J.

LOGICAL DESIGN AND NUMBER SYSTEMS

229:

Gurzi, Fred. **A high-speed multiplication process for digital computers.** *Comm. ACM* **3,** 4 (April 1960), 241–245.

Using jump shifts and three places, a parallel binary multiplication process is developed. The shift and simple addition of the multiplicand or its inverse is determined as a function of the last five bits of the shifted multiplier, and the bit last shifted out of the multiplier register. The option of a jump shift of three places permits the elimination of certain bit configurations as arguments of this function. This makes switching on the adder inputs to perform additions of different multiples of the multiplicand unnecessary and is a novel feature of the method. Because shifts of two and three places are possible, special logic hardware is needed for end configurations containing one, two, or three remaining bits in the multiplier. Multiplication of two n bit binary numbers will be accomplished in $n/3$ to $n/2$ bit periods. *John R. Pasta*, Kensington, Md.

230:

Wegner, Peter. **A technique for counting ones in a binary computer.** *Comm. ACM* **3,** 5 (May 1960), 322.

This short note describes a method for counting the number of 1's in a binary word (sometimes called sideways addition) which is particularly fast when the number of 1's is small. The method depends on the fact that if the logical operation "and" is performed on N and N − 1, where N is a positive binary number, the result is equal to N except that the least significant 1 has been eliminated.

M. V. Wilkes, Cambridge, England

231:

KNUTH, DONALD E. **An imaginary number system.** *Comm. ACM* **3,** 4 (April 1960), 245–247.

All complex numbers can be uniquely represented in the form $\sum d_r \cdot (2i)^r$, that is to the base $2i$, with digits d_r which are 0, 1, 2, or 3. Although unique, this representation is not particularly obvious (for example $-1 + i$ becomes 113.2), and an algorithm for converting ordinary complex numbers into this form is given. Rules for addition and multiplication are similar to the normal ones except that carries have to skip a column and change their sign; long division appears very difficult. A similar system with base $\sqrt{2i}$ is also described, which only requires the digits 0 and 1.

Christopher Strachey, London, England

232:

WADEY, W. G. **Floating-point arithmetics.** *J. Assoc. Comput. Mach.* **7,** 2 (April 1960), 129–139.

This article discusses and compares various types of floating-point arithmetic, each of which incorporates some sort of "significance indication." Questions pertaining to the detailed specification of arithmetic algorithms are discussed. In particular, rules for "corrective shift" in unnormalized "significant-digit" arithmetic are developed, according to a criterion of minimization of apparent relative error. A different kind of unnormalized arithmetic, characterized as "floating-point with probable error computation," is also described, and rules for handling zero fractions are given. The paper contains some statements which are misleading; for example, it is said that the purpose of significant-digit arithmetic "is to prevent the introduction of meaningless digits into the numbers involved in a computation," when in fact there is no practical way to avoid entirely the introduction of error, and the significant-digit scheme is intended only to give a better indication of accumulated error in certain situations. The statement that "the probable error in the absolute value of a number is implied by the presence of leading zero digits rather than being stated explicitly," made without a clear delineation of context, leads to an analysis based on the assumption of minimal errors in operands (i.e., a half unit in the last place), which is certainly not of general applicability. *R. L. Ashenhurst*, Chicago, Ill.

MANAGERIAL APPLICATIONS

233:

DANTZIG, GEORGE B. **A machine-job schedule model.** *Management Sci.* **6,** 2 (January 1960), 191–196.

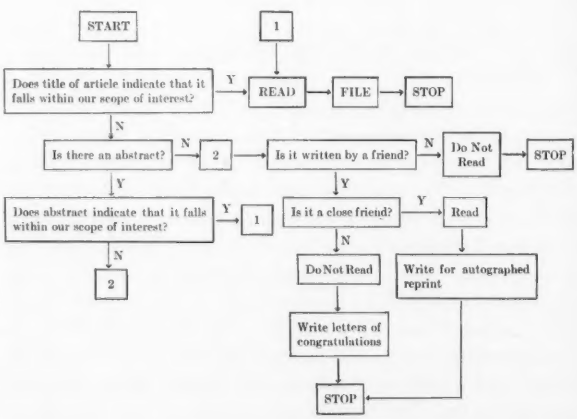
This paper makes use of a device proposed by Fulkerson and Ford for maximal multi-commodity network flows (*Management Sci.* **5,** 1 (1958), 97–101). A machine-job scheduling model is formulated that avoids the usual in-process inventories and thereby has fewer equations. The activities are the possible sequence for each job of machine steps and interspersed delays; this, of course, greatly multiplies the number of activities. However, a compact network representation of the set of possible activities is developed which permits generating just the activity to enter the basis on each iteration without explicitly generating the others. This is done by using one of the efficient procedures that now exist for computing the shortest route through a network (Dantzig, G. B.," On the Shortest Route through a Network," *Management Sci.* **6,** 2 (1960)). (*Author's Summary*)

Bernard A. Galler, Ann Arbor, Mich.

234:

SCHUCHTER, JEROME P. **Marriage——with problems.** *Comm. ACM* **3,** 2 (February 1960), 87–90.

In determining whether or not we should read an article, many of us, the writer included, tend to operate their personal documentation and retrieval system in the classical manner. If we were to flow-chart this process, it would go something like this:



I am afraid that when I received my February 1960 issue of *Communications of the ACM*, the article in question, "Marriage—with Problems," by Jerome P. Schuchter did not pass any of the tests in my program (since my interest in marriage and problems does not extend to

doing any reading about it, there was no abstract, and Mr. Schuchter is not a friend of mine—a situation I hope to correct someday), and hence, the article was not read at that time. I would like to suggest that if this article failed to pass your documentation program, you find a copy as soon as possible and correct your program to handle worthwhile exceptions.

In this article we have an exceptionally frank discussion of how an important segment of a manufacturing organization (Federal Pacific Electric Company) was allowed to wither away, and how the application of good dose of fertilizer—in the shape of a disorganized use of an ambitious machine procedure and a RAMAC—almost ruined the soil (and climate) for further computer applications.

Mr. Schuchter states that although they were warned by the computer industry *five years ago* not to rush in, they made the following errors which he classifies as:

"(1) *The pedestal error.* This marvelous equipment is set up on a pedestal and expected to perform magical maneuvers far above the common range of past company experience.

(2) *The "leave-it-to-experts" error.* The terms and potentials of the equipment are so far outside past management experience that the working-out of problems is left to experts. Usually these experts have limited ranges and solve problems expediently rather than in depth.

(3) *The remote control error.* In the press of other duties, executive administration of the system deteriorates into passing on procedures rather than shirt-sleeve participation."

These mistakes led to a much too elaborate and sophisticated procedure to handle the company's distribution system, voluminous reports fraught with errors, and to no cooperation and support of the people who had to work with the system. Faced with the problem of making it work or plowing it under, the following steps were taken: (1) tightening of internal paperwork, (2) *responsibility assigned to a corporate officer,* (3) simplifying of the procedures.

The unfortunate part of the current state of the installation is, as the author puts it, "The machine is developing—with more speed and accuracy—into a reasonable facsimile of a crew of efficient clerks." They have been forced to fall back on the "bread-and-butter" type use of the computer. This is always unfortunate, but more so when an organization which is willing to attempt the ultimate in efficient and effective use of a computer—the use of the computer as a decision-making tool for management—suffers a set back due to a poorly organized plan of action.

Federal Pacific is, however, moving along cautiously and has high hopes of making their marriage to RAMAC a reality with a happier and more fruitful outcome. With deep feeling and sympathy for their efforts, we say better luck next time. May the next nine months yield a rich harvest. *Saul I. Gass,* Washington, D.C.

[This paper, described in Review No. 234 above, is "near-identical" with a paper by the same author, under a different title, in a different publication. Whether the same paper deserves publication twice would appear to merit discussion by the editors of the two publications involved and the author.—Ed.]

235:

EVERETT, JAMES E. **Counting for high speed control.** *Automation* **7,** 6 (June 1960), 92–96.

The author describes in some detail how transistorized digital controllers (commonly referred to as electronic counters) are used in everyday industrial production operations to accurately count pulses from sensing devices at speeds up to 75,000 counts per second, actuate various functions of other equipment when a preset number is reached, and instantaneously reset to zero with no loss of count. Three basic operating functions of the electronic controller are described—sensing, indicating and control. The author's illustrations as to how the electronic controllers would be applied in various manufacturing uses, such as cutting-to-length, motor speed, paperdrawn, material positioning, etc., provide the reader with an indication of the broad industrial potentialities of the high-speed digital electronic preset controller.

A. D. Hestenes, Detroit, Mich.

236:

MCGUINNESS, JOHN S. **A managerial game for an insurance company.** *Operations Res.* **8,** 2 (March-April 1960), 196–209.

The author describes an interesting variation on the usual managerial game, in that he has specialized it to the field of casualty insurance. He provides not only the information needed to understand the play of the game, but also covers many of the considerations of program design. While not likely to interest the person remote from casualty insurance field, the article should prove quite stimulating to those who have access to data processing systems and have a stake in the field of casualty insurance.

Herbert F. Mitchell, Jr., New York, N. Y.

237:

LEVITAN, R. E. **The optimum reject allowance problem.** *Management Sci.* **6,** 2 (January 1960), 172–186.

This article is concerned with the problem of specifying the optimum production lot size by balancing the cost of producing too many items against the risk and cost of not having produced enough to meet requirements. A sequential algorithm is developed for calculating the optimum quantity. The article appears to be directed to those people who are trained in mathematics. Others interested in using the algorithm will need to obtain a mathematician as an interpreter. *Kendall R. Wright,* Santa Monica, Calif.

238:

Computer monitors flow variables in gas dispatching system. *Automation* **7,** 6 (June 1960), 87–89.

This describes the use of a LIBRATROL 500 computer in the on-line calculation of gas-flow totals from data telemetered from multiple remote metering points. The installation at the Public Service Company of Colorado gives the central dispatcher hourly gas-flow totals to aid him in making operating decisions.

Differential pressures from orifice meters, static pressures, and temperatures from an unstated number of remote points are multiplexed over phone lines to the central station where the readings are recorded on a battery of Bristol circular chart recorders. Retransmitting potentiometers on each recorder provide the inputs to an analog-to-digital converter which feeds the computer. The computer is programmed to calculate all flow-rates and total flows every 6 minutes and to type out hourly statements of totals. This occupies the computer 1½ minutes out of every 6, the rest of the time being available for off-line calculations.

The computer operation replaces a manual calculation which took 30 to 45 minutes each hour. No reference is made to any economic justification of the installation.

Eric A. Weiss, Springfield, Pa.

239:

PATTERSON, PATT. **Comparing notes.** *Automation* **7,** 6 (June 1960), 49–52.

This article is a run-down of the opinions expressed in Los Angeles, April, 1960, at the 2nd Symposium for Pilot Plant Automation. In general, the accomplishments to date of computer control of processes has been limited to the chemical and petroleum processing industries. The computer control concept is being held back in other fields primarily because of the lack of sensing devices rather than the ability to program the computer. In industry, time is of the essence; automation is no longer a question, but a necessity. It is very possible that factories of the future will be planned with complete computer control of all work flow.

Marvin Howard, Canoga Park, Calif.

240:

Production data system improves management control. *Automation* **7,** 6 (June 1960), 80–81.

The article expresses satisfaction with the improved internal communications of production control data, elimination of certain management control reports, a 42% reduction in key punch time, and a savings of over 425 man hours daily at Norair Division of Northrop Corp., through use of a Friden COLLECTADATA system and an IBM 704 Computing Center. Manufacturing is operated and adjusted from reports produced on the midnight to 7:00 A.M. shift. Other computer hours are used for engineering and scientific problems. Fixed and variable production data is accumulated on 8-level punch paper tape at twenty centrally located receiving units from 97 dispersed transmitter units. The punch tapes are transported to the computing center where they are first converted to cards and then to magnetic tape for computer use. The Friden data collection system is somewhat similar in general purpose to the Stromberg Transacter, and the IBM 357 data collection equipment. The article is too general to be used for specific applications guidance.

William V. Crowley, Redendo Beach, Calif.

241:

WINTERS, PETER R. **Forecasting sales by exponentially weighted moving averages.** *Management Sci.* **6,** 3 (April 1960), 324–342.

This paper discusses a method applicable to forecasting individual product sales for inventory control and production scheduling purposes. It is based on the analysis of a time series taken out of context. The forecast of sales T periods in the future ($S_{t,T}$) is given by:

$$S_{t,T} = (\tilde{S}_t + TR_t)F_{t-L+T} \qquad T = 1, 2, \cdots, L$$

where t specifies the current period, the F's represent the seasonal factors, the R's the additive trend factors, and L the number of periods in a season. Because the F's and R's are adjusted each period, the forecasts soon reflect changes in these basic parameters. The required estimates are given by the following formulas:

$$\tilde{S}_t = A\frac{S_t}{F_{t-L}} + (1 - A)(\tilde{S}_{t-1} + R_{t-1})$$

$$F_t = B\frac{S_t}{\tilde{S}_t} + (1 - B)F_{t-L}$$

$$R_t = C(\tilde{S}_t - \tilde{S}_{t-1}) + (1 - C)R_{t-1}\,.$$

where S_t is the actual sales during period t, and A, B, and C are constants.

The method is then applied to three different examples. The initial values of S, R, and the F's and the values of A, B, and C are determined empirically. The latter are found by covering the set of all possible (A, B, C) with a grid, calculating for each grid point the "standard deviation of the forecast error," and choosing the point with the smallest such standard deviation. The effect of choosing different values for the constants is discussed. The final section compares the method to two other forecasting techniques.

Carl H. Pollmar, Ann Arbor, Mich.

242:

BAKER, C. T.; and DZIELINSKI, B. P. **Simulation of a simplified job shop.** *Management Sci.* **6,** 3 (April 1960), 311–323.

This is a report of the results of some digital computer simulation studies of a simplified model of a job shop production process. Such factors as the average effectiveness of schedules under the impact of random variations in processing times and the effect of changing operating policies are considered. The average manufacturing times and predictability of completion times were used as measures of effectiveness. (*Authors' Abstract*)

Robert F. Wheeling, Paulsboro, N. J.

243:

TAKÁCS, LAJOS. **Transient behavior of single-server queuing processes with recurrent input and exponentially distributed service times.** *Operations Research* **8,** 2 (March-April 1960), 231–245.

The following is quoted from the author's summary:

"Customers arrive at a counter at the instants $\tau_1, \tau_2, \cdots, \tau_n, \cdots$, where the inter-arrival times $\tau_n - \tau_{n-1}$ $(n = 1, 2, \cdots, \tau_0 = 0)$ are identically distributed, independent, random variables *with distribution function* $F(x)$. The customers will be served by a single server. The service times are identically distributed, independent, random variables with exponential distribution *with mean life* μ^{-1}. Let $\xi(t)$ denote the queue size at the instant t. If $\xi(\tau_n - 0) = k$ then a transition $E_k \to E_{k+1}$ is said to occur at the instant $t = \tau_n$. The following probabilities are determined:

$$p_{ik}^{(n)} = P\{\xi(\tau_n - 0) = k \mid \xi(0) = i + 1\},$$

$$P_{ik}^{*}(t) = P\{\xi(t) = k \mid \xi(0) = i\},$$

$G_n(X)$ = the probability that a busy period consists of n services and its length is at most x, and further the distribution of the number of transitions $E_k \to E_{k+1}$ occurring in the time interval $(0, t)$."

The author's theorem 1 is now quoted to show the sense in which the probabilities $p_{ik}^{(n)}$ are "determined".

"Theorem 1. We have for $|z| \leqq 1$ and $|w| < 1$ that

$$\sum_{n=0}^{\infty}\sum_{i=0}^{\infty} p_{ik}^{(n)} z^i w^n =$$

$$\frac{(1-w)(1-z)z^{k+1} + w\{z-\varphi[\mu(1-z)]\}[1-g(w)][g(w)]^k}{1-w)(1-z)\{z-w\varphi[\mu(1-z)]\}}$$

where $z = g(w)$ is that root of the equation

$$z = w\varphi[\mu(1-z)],$$

which has the smallest absolute value. Here $\varphi(s)$ is the Laplace-Stieltjes transform of $F(x)$."

The remainder of the results are of this type except for Theorem 3 which is qualitative in nature. Here $\alpha = \int_0^{\infty} x\, dF(x)$.

"Theorem 3. The states of the Markov chain $\{\xi_n\}$ are recurrent nonnull states if $\mu\alpha > 1$; they are recurrent null. states if $\mu\alpha = 1$, and transient states if $\mu\alpha < 1$."

Peter Frank, Syracuse, N. Y

MECHANICAL LANGUAGE TRANSLATION

244:

CLEMENTS, ROBERT J. **Literature by electronics.** *Saturday Rev.* (July 16, 1960), 13–15, 39–40.

The author, writing for a sophisticated literary audience, views automatic machine translation (with some tongue-in-cheek reservations) as the "most powerful instrument for the eventual dissemination of literature (that) has come along since the invention of printing, which also progressed to the point of confounding critics and skeptics."

After giving his readers a popularized explanation of the IBM MARK I (1,800 words per minute Russian-English, 60,000 entries representing 600,000 Russian words with a potential of 400,000 entries), the author credits England, the U. S., and Russia with advances in machine translation, and is most critical of lack of progress in the field by the French. He points out that a mid-1940 announcement by Dr. Andrew D. Booth (CR Editorial Board member) that the German of Goethe would "soon" be translated into the English of Wordsworth had most sensitive literary scholars agog.

In the reviewer's opinion, the author arrives too close to the hackneyed conclusion that Russian energy and initiative have been most responsible for goading the U. S. into progress in machine translation. He points out that 2,600 full-time and 26,000 part-time translators are at work at the Soviet All-Union Institute for Scientific and Technical Translation—and they aren't working on Faulkner, T. S. Eliot or Hemingway! He does, however, recognize that IBM's first 250-word Russian-English vocabulary was developed for a general purpose computer (model not specified) four years prior to the 1958 Congress on Automatic Translation in Moscow. The U. S. Air Force is the biggest government spender on technical translation.

The author foresees a number of interesting developments once the automatic machine translators arrive on the fiction scene. A major consequence will be that thousands of book and story manuscripts, many of them unpublished *and* untranslated works of great authors, will be available to the whole world for the first time. This will result in a sort of bookstore-publisher-book club-book reviewer-literary agent explosion. Publishers who invest in machine translation will want to get the most for their money and the demand for automatic reading equipment will be tremendous. The author humorously offers that a new American writer could receive a letter from his literary agent informing him that his first novel had been machine translated into seven languages, with a P.S.: "It will be published in English next year by Random House".

A danger of machine translation, says the author, will be the reduction of motivation to study languages. Americans, particularly, will be greater linguistic isolationists than ever before. However, this will be offset somewhat by the skepticism that has forever existed about the ability of *anybody* (or anything) to translate so as to be faithful to the author. How much greater will be the skepticism of literary scholars about the ability of the machine! At any rate, the machine will be impervious to criticism. Unlike an early French translator who failed to do justice to a Greek text, the MARK I or II will not be burned at the stake!

Here, summarized, are what the author believes are limitations on machine translation of fiction and other non-technical writing: (1) a machine will never have the *necessary* erudition and sophistication of a human translator; (2) a bi-lingual machine is no substitute for a multilingual human; (3) a machine cannot capture the vestigial

shadings or dialetical qualities of input languages; (4) a machine cannot distinguish between energetic German, lyrical Italian, or formal Castilian. It would render semantic "literal" translations only; (5) a machine is most limited in handling idioms. For example, how would a machine convert *Mit Wolfen muss man heulen* ("With the wolf pack one must howl") into "When in Rome do as the Romans do"? (He admits that some idioms and other imput language characteristics *can* be put in glass disc storage); (6) the machine is further limited by weaknesses and inconsistencies of the input languages.

In the reviewer's opinion, a machine literalization of some of today's technical text would make a tremendous contribution to the communication of complex ideas. It might be a translation of "English" into *English*! Then there is the gag about the machine which mistranslated Mark 24:41 ("the spirit is willing but the flesh is weak") as "the liquor is good but the meat is terrible".

Roger P. Hansen, Chapel Hill, N. C.

MEDICAL AND PSYCHOLOGICAL APPLICATIONS

245:

VANDENBERG, STEVEN G. **Medical diagnosis by computer: recent efforts and outlook.** *Computers and Automation* **9,** 2 & 2B (February 1960), 12–14.

The main roles of computers in medical diagnosis are categorized as: (1) simulation, (2) statistical analysis, and (3) logical diagnosis. Discussion is limited almost exclusively to the latter, particularly as related to psychiatric diagnosis. It is stated that, "in the diagnosis of mental diseases there exists as yet no . . . orderly system of clearly understood relationships". This orderly system is considered to be an essential prerequisite to programming a computer for logical diagnosis. Suggestions are made regarding ways of collecting data which might help to bring about this order.

Although it is implicit in the discussion, it is not clearly indicated that the first two roles, simulation and statistical analysis, are probably essential in obtaining estimates of probabilities and parameters which would be necessary in logical diagnosis programming.

In addition, there is considerable speculation about, (1) a network of computers tied in with various record keeping agencies for up-dating cumulative records of individuals, (2) psychological attitudes as influenced by computers and, (3) legal aspects of decisions made by computers.

H. B. Wells, Chapel Hill, N. C.

246:

GOLDSTEIN, MOÏSE H., JR. **A statistical model for interpreting neuroelectric responses.** *Information and Control* **3,** 1 (March 1960), 1–17.

The following author's abstract is an adequate review: "Neuroelectric activity recorded after presentation of a controlled stimulus is called an 'evoked response'. Evoked responses are random, in that repeated presentations of a stimulus do not produce identical responses despite all effort to maintain identical conditions for all stimulus presentations. Responses may then be described statistically. The present model attempts to relate statistical characteristics of evoked responses, recorded by gross electrodes, to the statistical activity of the neural elements that contribute to the responses. The model postulates one or more populations of elements which, when they fire, contribute elemental wave forms to a gross response in which these waveforms are linearly summed. The statistical behavior of the elements in a population is described by their instantaneous firing rate, which is a function of time. In terms of the model, the statistical properties of the gross response (such as the mean and variance, both of which are functions of time) are shown to be related in a simple way to the instantaneous firing rates and elemental waveforms of the populations that contribute to the response. The model is an extension of the shot-noise model to time-variant phenomena; but some of the assumptions of the shot-noise model (specifically, statistical independence of firings) are relaxed."

Bert F. Green, Lexington, Mass.

NON-NUMERIC APPLICATIONS

247:

FINDLER, N. V. **Some remarks on the game "Dama" which can be played on a digital computer.** *Comput. J.* **3,** 1 (April 1960), 40–44.

Faced with the task of making a contribution to the problem of programming computers to play games, and being seriously limited by the size of the available machine memory, Mr. Findler wisely chose to study a fairly simple, non-trivial, game rather than a more complicated game such as checkers or chess. In this well-writen paper, the author discusses machine procedures for the game of DAMA, a chess-board game that is quite popular in Central Europe. He formulates some evaluation functions for this game and describes an operating program based on a simplified form of his proposed general playing strategy. The paper concludes with a suggestion for a learning process in which the machine would play games with itself using competing sets of evaluation functions for the two opposing sides. In this way, it could test a series of different strategies to arrive at an optimum strategy which might win against all others.

A. L. Samuel, Yorktown Heights, N. Y.

248:

BLAIR, CHARLES R. **A program for correcting spelling errors.** *Information and Control* **3,** 1 (March 1960), 60–67.

The article describes a heuristic process specifically designed for the type of spelling errors normally made by people, but not effective for correcting other types of errors such as random errors caused by malfunctioning of a machine or transmission line. The key to any spelling correction scheme is the selection of an appropriate measure of "similarity" between a misspelled word and the various entries in a dictionary of correctly spelled words. The article describes a simple algorithm for automatically producing an abbreviation for any word based upon two empirically constructed functions. One function indicates the desirability of deleting a letter and is based upon the frequency of occurrence as errors in misspelled words. The second function gives weight to the position of a letter in the word in such a way that beginning and ending letters have lower probability of being deleted from the abbreviations. Assuming that the name and position of a letter independently determines the desirability of rejecting it, one can form an r-letter abbreviation of an n-letter word by deleting the $n-r$ letters which have the largest product. (Coding of the algorithm is simplified by adding three-bit logarithms of the two functions.) In use, the abbreviation algorithm is applied to all correctly spelled words in the dictionary beforehand, giving a parallel dictionary of four-letter abbreviations. The correct spelling of a word is then determined by matching four-letter abbreviations and selecting the associated word of the dictionary. Ambiguous cases are resolved by longer abbreviations. In a sample set of commonly misspelled words, the program correctly identified 89 out of 117 misspelled words, while incorrectly identifying only 2. *Reviewer's comment*: While it is not clear how this procedure would fare with a large dictionary, it appears that it could be teamed with other spelling-correction procedures, such as those using phonetics, to provide an effective procedure for the correction of the vast majority of human spelling errors.

Douglas T. Ross, Cambridge, Mass.

249:

PAPWORTH, D. G. **Computers and change-ringing.** *Comput. J.* **3,** 1 (April 1960), 47–50.

This paper deals with the problems of change-ringing on church bells and the methods of solution of the problems using a Pegasus computer. The problem of change-ringing can be described mathematically by giving n numbers $1, 2, \ldots, n$, representing church bells with different musical notes, and generating in some order according to certain restrictions all $n!$ permutations of the numbers. Further, in the problems of composition a shorter sequence of permutations containing no repetition of a permutation, except for beginning and ending with $1, 2, \ldots, n$, is desired. The paper indicates how Pegasus was used to obtain compositions according to given simple rules which were consistent with the restrictions.

Ward Sangren, San Diego, Calif.

250:

PRAGWITZ, DAG; PRAGWITZ, HÅKAN; AND VOGHERA, NERI. **A mechanical proof procedure and its realization in an electronic computer.** *J. Assoc. Comput. Mach.* **7,** 2 (April 1960), 102–128.

The authors of this paper appear to have achieved a realization in electronic digital computing of a proof procedure for the first order predicate calculus. I retain some doubts as to the use of the adjective "effective" applying to this proof procedure. The presentation is scholarly in that the authors have examined the literature on this subject carefully. The whole paper presents, however, a viewpoint which still needs to be established that electronic digital computers can really furnish a solution in the proof procedures for predicate calculus. There seems to be no question that the electronic digital computer furnishes an extremely powerful capability in connection with rapid determination of the results of sentential calculus or Boolean algebra. However, the effectiveness of such computers in really providing a guide to mathematicians in the difficult area of establishing theorems in the predicate calculus remains yet to be ascertained. The work of the authors of this paper in this direction should certainly not be discouraged and the present paper reflects a considerable amount of sober thinking on this subject. *Howard T. Engstrom*, New York, N. Y.

251:

SWIFT, J. D. **Construction of Galois fields of characteristic two and irreducible polynomials.** *Math. Comput.* **14,** 70 (April 1960), 99–103.

"The primary purpose of this paper is to provide a practical method of constructing Galois fields of characteristic 2 of large orders and thereby simultaneously give a practical way of generating a large supply of polynomials of high degree irreducible modulo 2. These polynomials are of special interest in connection with the theory of linear recursive sequences." If 2 is a primitive root of the prime p, then $(x^p + 1)/(x + 1)$ is irreducible (mod 2). Thus, $GF(2^{p-1})$ is generated, and in turn each $GF(2^d)$ for $d \mid (p - 1)$, when a primitive element of the former field is found. The main computational tool is a routine for SWAC which generates powers of polynomials moduli 2 and some fixed polynomial; this routine employs operations similar to quadruple precision multiplication and division. For each prime $p \leqq 139$ having 2 as a primitive root, and each divisor d of $p - 1$ with $2 < d < p - 1$, a generating polynomial of $GF(2^d)$ is printed in compact form. *E. T. Parker*, St. Paul, Minn.

NUMERICAL MATHEMATICS

252:

DIMSDALE, B. **Characteristic roots of a matric polynomial.** *J. Soc. Indust. Appl. Math.* **8,** 1 (March 1960), 218–223.

Let $A_0, A_1, \cdots, A_n$ be square matrices of order m and let $R(\lambda) = A_0 + A_1\lambda + \cdots + A_n\lambda^n$. The author considers the problem of finding the roots of det $R(\lambda)$. Ignoring earlier contributions to the same problem which have been successfully tested in practice [see I. Tarnove, *J. Soc. Indust. Appl. Math.* **6** (1958), 163–171], he proposes to set up the companion matrix (of order mn) of $R(\lambda)$ and to reduce the problem to a standard eigenvalue problem of order mn by elementary row and column transformations. The form of the companion matrix given in the paper is erroneous. *Peter Henrici*, Los Angeles, Calif.

253:

DRENICK, R. F. **Mathematical aspects of the reliability problem.** *J. Soc. Indust. Appl. Math.* **8,** 1 (March 1960), 125–149.

The author introduces a concept of reliability which is based on the statistical notion of expected economic gain (or loss). More specifically, the economic gain, $U(t)$, due to the use of a certain device for time t, is the statistical average of a random gain function. The random gain function depends on the number and occurrence times of failures up to time t as well as on the replacement policy. When other random variables enter in, the conditional expected gain up to time t, given the failure times and number, is assumed known. The derivative, $u(t) = dU(t)/dt$, is defined as the "reliability of [the] device up to time t."

A class of gain functions suitable for renewal problems is defined and sufficient conditions are given for the existence of $u = u(\infty)$ as well as for solutions of the form: $u(t) = u$. Certain formulae are presented and illustrated in connection with determining replacement rate, maintenance ratio, mission success ratio, mission survival probability, etc. The choice of random processes representative of gradual deterioration is discussed.

The latter part of the paper is concerned with preventive maintenance and duplication of devices. In these sections the equipment policy is assumed to be at least partly under the control of the firm. A class of replacement (or duplication) policies is assumed from which typically it is required to choose a policy maximizing the asymptotic mean revenue, u. Applications are made to periodic maintenance, marginal checking, and reliability improvement through the use of redundant devices.

John H. MacKay, Atlanta, Ga.

254:

LOWAN, ARNOLD N. **On the propagation of round-off errors in the numerical integration of the heat equation.** *Math. Comput.* **14,** 70 (April 1960), 139–146.

The purpose of this paper is to obtain bounds for the propagation of round-off errors in stable explicit and implicit stepping ahead procedures. Both constant and variable boundary conditions are considered. Error bounds are obtained which are sharp enough to be helpful, even for a large number of time steps. The author begins with the four-point explicit formula where his problem is quite simple; and develops a method sufficiently general to be applicable to implicit methods, in which the error propagation depends on how the arithmetic is done. This leads him, as one would expect, to a study of the error involved in the solution of tridiagonal systems. The results here are based partly on an earlier RAND report by the author. This paper is closely related to "Round-Off Error in the Numerical Solution of the Heat Equation" by Jim Douglas, Jr., *JACM* **6,** 1 (January 1956), 48–58, the main difference between the two papers being that Lowan considers the problem somewhat more generally.

Robert W. Mann, Chapel Hill, N. C.

255:

VIONNET, MONIQUE, **Approximation de Tchebycheff d'ordre n des fonctions sin x, (sin$x$)/x, cos x et exp x.** (Tchebycheff approximation of order n of the functions sin x, (sin x)/x, cos x, and exp x.) *Chiffres* **2,** 2 (June 1959), 77–96. (French)

Explicit coefficients for polynomial approximations are given for the functions listed in the title. The coefficients are found from the truncated series expansions in Tchebycheff polynomials. Because of the rapid convergence of the series, the error bounds are very close to the best possible. (For (sin x)/x and cos x, the coefficients and error bounds for the polynomials of degree $\leqq 6$ have been given to 10 decimals by G. Hornecker [*Chiffres*, **1,** 4 (December 1958), 157–169]. All polynomials are given for which the error bound is greater than approximately 10^{-23}. The ranges for sin x, (sin x)/x, and cos x are $|x| \leqq \pi/4$ and for exp x is $0 \leqq x \leqq (\log_e 10)/2$. The author gives tables showing the actual error in many cases and remarks that of them, only two or three exceed the theoretical bound, and only by one unit, and that these are caused by rounding errors. The error bounds should have been increased to include rounding error and so guarantee no exceptions. *Leonard Tornheim*, Richmond, Calif.

256:

CHATELET, F.; LANSRAUX, G.; AND MILLION, B. **Tables pour le calcul approché des integrales finies de Hankel.** (Tables for the approximate calculation of finite Hankel integrals). *Chiffres* **2,** 4 (December 1959), 233–237. (French)

An approximation $g(y)$ to $G(y) = \int_0^1 F(x)J_0(xy)\,dx^2$ can be obtained by replacing $F(x)$ by an N-point Lagrange interpolant $\sum F(x_i)P_i(x)$. This gives $g(y) = \sum F(x_i)L_i(y)$ where $L_i(y) = \int_0^1 P_i(x)J_0(xy)\,dx^2$ so that tables of $L_i(y)$ will be convenient; there is a discussion of the errors in this approximation. In view of certain applications, there are good reasons for choosing x_i so that

the x_i^2 are equally spaced in (0, 1). In this case, with $N = 11$, the values of the $L_i(y)$ are given to ten decimals for $y = 0(1)12$. *John Todd*, Pasadena, Calif.

257:

LONGMAN, I. M. **On the utility of Newton's method for computing complex roots of equations.** *Math. Comput.* **14,** 70 (April 1960), 187–188.

The author observes that Newton's method for solving equations $f(x) = 0$ is applicable to the case of complex roots. However, an initial imaginary approximation must be used to obtain an imaginary root if $f(x)$ has only real coefficients. He gives illustrations of successful applications of the method to a quadratic equation and to a transcendental equation involving the square root of the unknown. For convergence, the author refers to Householder, *Principles of Numerical Analysis* (McGraw-Hill, New York, 1953).

James Ward, Holloman Air Force Base, N. M.

258:

ANUCHINA, N. N.; AND YANENKO, N. N. **Implicit splitting schemes for hyperbolic equations and hyperbolic systems.** *Doklady Akademii Nauk SSSR* **128,** 6, 1103–1105. (Russian)

K. A. Bagranovskiy and S. K. Godunov approximated a system of partial differential equations of hyperbolic type by a one-dimensional explicit difference scheme which was stable under certain assumptions on the step. The authors use an analogous method which is denoted as a splitting method, in order to approximate equations of hyperbolic type for an arbitrary step by one-dimensional implicit difference schemes, e.g., to the equation.

$$\frac{\partial^2 p}{\partial t^2} - \sum_{i=1}^{m} \frac{\partial^2 p}{\partial x_i^2} = 0 \tag{18}$$

there corresponds the splitting scheme

$$\frac{p^{n+1+\frac{s}{m}} - p^{n+1+\frac{s-1}{m}} - p^{n+\frac{s}{m}} + p^{n+\frac{s-1}{m}}}{2} = \frac{\Delta_s \Delta_{-s}}{h_s^2} \frac{p^{n+1+\frac{s}{m}} + p^{n+1+\left(\frac{s-1}{m}\right)} + p^{n+\frac{s}{m}} + p^{n+\frac{s-1}{m}}}{4}. \tag{19}$$

The scheme (19) approximates (18), is spectrally stable and consequently convergent. Linearized equations of the gas dynamics are considered in detail. There is one Soviet reference.

(From the Abstract)

259:

BESSMERTNYKH, G. A. **A simultaneous finding of two characteristic numbers of a self-adjoint operator.** *Doklady Akademii Nauk SSSR* **128,** 6 (1959), 1106–1109. (Russian)

Let A be bounded self-adjoint positively defined operator in the real Hilbert space H; let M and m be the least upper bound and the greatest lower bound of the spectrum of A; let m be isolated; let m_1 be the least number of the spectrum being greater than m. For the determination of m, M. A. Krasnosel'skiy proposed the following method of iteration:

$$x_{k+1} = x_k - 2\gamma_k \Delta_k \tag{1}$$

where

$$\Delta_k = Ax_k - \mu_k x_k, \tag{2}$$

$$\mu_k = \frac{(Ax_k, x_k)}{(x_k, x_k)} \tag{3}$$

$$\gamma_k = \frac{(\Delta_k, \Delta_k)}{(A\Delta_k, \Delta_k)}. \tag{4}$$

Under certain assumptions the sequence μ_k converges to m. The sequence $\{y_k\}$ converges to y with respect to the direction if

$$\lim_{k\to\infty} \sin^2(y_k, y) = \lim_{k\to\infty} \left[1 - \frac{(y_k, y)^2}{\| y_k \|^2 \| y \|^2}\right] = 0.$$

THEOREM 1. *Let m and m_1 be isolated points of the spectrum of A. Let*

$$m > \frac{M}{2}, \tag{5}$$

and let x_0 be not orthogonal to the invariant subspaces L_m and L_{m_1} of A. Then the sequence $\overline{\Delta}_k = \Delta_k / \| \Delta_k \|$ converges with respect to the direction to a vector of L_{m_1} and the sequence $1/\gamma_k$ converges to m_1.

Theorem 2 considers the case

$$m < \frac{m_1}{2} \tag{6}$$

and shows under certain assumptions on x_0 that $\overline{\Delta}_k$ converges with respect to the direction to an eigenvector of L_M and $1/\gamma_k$ converges to the M assumed to be isolated.

Theorem 3 shows that if neither (5) nor (6) is valid, then in general the sequence $\overline{\Delta}_k$ diverges.

Finally the convergence of (1)–(4) is accelerated with the aid of a method of L. A. Lyusternik. There are four Soviet references. *(From the Abstract)*

260:

WILEY, C. R. JR. **Advanced engineering mathematics, 2nd edition,** McGraw-Hill, New York, 1960, 11 + 696 pps., $9.00.

The second edition of this popular book has been completely rewritten, and begins with a new chapter on determinants and matrices. The numerical methods chapter has been replaced by one on finite differences which covers: divided differences, difference tables, summation, the standard interpolation formulae with error terms, numerical differentiation, and integration, including the Euler-Maclaurin and Gregory formulas, Milne's method (no indication of instability, and Adams-Bashforth ap-

pears as an exercise), difference equations, and least squares with orthogonal polynomials. An appendix on Graeffe's root squaring method is included. Thus, numerical methods are gradually infiltrating the engineering curriculum, but have a way to go yet.

Having given a biased review for the special interests of computer experts, it is only fair to give an idea of the whole book. This is perhaps best done by listing the chapter headings.

1 Determinants and Matrices
2 Ordinary Differential Equations of the First Order
3 Linear Differential Equations with Constant Coefficients
4 Simultaneous Linear Differential Equations
5 Finite Differences
6 Mechanical and Electrical Circuits
7 Fourier Series and Integrals
8 The Laplace Transformation
9 Partial Differential Equations
10 Bessel Functions and Legendre Polynomials
11 Vector Analysis
12 Analytic Functions of a Complex Variable
13 Infinite Series in the Complex Plane
14 The Theory of Residues
15 Conformal Mapping

From these chapter headings, it is evident that a wealth of material is being covered; what is not evident from mere chapter headings is the clarity and skill of the author in presenting it. Numerous worked examples in the text help the reader over many difficult points. The author has not sacrificed accurate presentation, though at times he merely cites necessary mathematical theorems and then goes on with an explanation of the meaning rather than getting unnecessarily involved in their proofs. The author's judgment on this is excellent.

R. W. Hamming, Murray Hill, N. J.

261:

KUNTZMANN, J. **Evaluation de l'erreur sur un pas dans les méthodes à pas séparés** (Evaluation of the error at one step using a method of separate steps). *Chiffres* **2,** 2 (June 1959), 97–102. (French)

The error at one step in integrating the equation $y' = Y(y, t)$ $(y(t_0) = y_0)$ numerically is defined as $y_i(t_{i+1}) - y_{i+1}$ where y_{i+1} is the value given at t_{i+1} by the numerical method, and $y_i(t)$ is the integral of the equation passing through the point (t_i, y_i). By using Taylor's series to find the equation relating the values of $y_i(t)$ and its derivatives at several neighboring points, and by replacing the values of $y_i(t)$ in this equation by their equivalents in terms of the numerical solution and the error at the various steps, an equation for the error in terms of the numerical solution of y_i and $Y(y_i, t)$ at several neighboring points is found. A list of such formulas appropriate to various orders of integration is given, and it is stated that the formulas have produced satisfactory results when used.

The paper starts out to treat a set of two first-order differential equations, but only a single first-order equation is actually considered. Also, in the opinion of the reviewer, the treatment is quite terse and not well described—e.g., the quantity ϵ_i used throughout is never specifically identified with the error defined initially.

The method deserves consideration as an interesting alternative to such usual methods of single-step error estimate as integrating twice with two different interval steps, or estimating higher derivatives by means of high order differences. *Phyllis Fox*, Cambridge, Mass.

262:

● KANTOROVICH, L. V.; AND AKILOV, G. P. **Functional analysis of normed spaces.** Gasudarstvennoe Izdatel'stvo Fiziko—Matematicheskoe Literaturii, Moscow (1959). 684 pp. 23.05 roubles. (Russian)

This book starts with an exposition of some of the basic principles of functional analysis and continues with a section, about 250 pages long, devoted to the application of these principles to the solution of equations. This latter part will be of special interest to numerical analysts and to some computer users.

The first part of the book, entitled "Linear Operators and Functionals", introduces those basic concepts of functional analysis that are needed for abstract discussions about general types of equations. These concepts include: normal spaces, metric spaces, linear topological spaces, linear operators and functionals, spaces of operators and functionals, convergence properties, analytical continuation, and completely continuous and adjoint operators.

The second part, entitled "Functional Equations", deals with the application of these concepts to the solution of linear and non-linear equations. Firstly, the inverse of a linear operator is discussed. There is a chapter on the operator equation $x - \lambda U(x) = y$, where u is a linear operator, λ is a numerical constant, y is a known "vector", and x is an "unknown" vector. After that, two approaches to the solution of linear equations are discussed: methods based on the solution of simplified equations approximating the original equation, and gradient methods. The last three chapters are about general, not necessarily linear, operator equations. Several types of theorems are stated about the existence of solutions of operator equations and also about bounds to the errors of approximation to these solutions. The Gâteau and Fréchet derivatives of operators are defined and discussed. Finally, there is a description of the extension of Newton's method, pioneered by Kantorovich himself, which allows its application to general types of equations. While all this formulation is abstract, it is illustrated throughout by examples of applications to important classes of particular equations: systems of algebraic equations and of ordinary differential equations, elliptic partial differential equations, and integral equations. But hardly any actual numerical examples are discussed.

At the end of the book, about 50 basic works on functional analysis and allied subjects, together with 200

references to relevant papers, are listed. There is a subject index. The exposition and general presentation of this book is on the whole clear and easy to follow, though there are misprints in the statements of a few of the theorems. However, some topics have been omitted which would have been useful to the numerical analyst. No attempt has been made to formulate a general theory of very rapidly converging iterative processes. Only one particular example of these processes is discussed, namely Newton's method, though others have been described in the mathematical literature, especially in Russia. The authors could usefully have mentioned several interesting particular iterative processes having quadratic convergence: the Hotelling-Lonseth method for the inverse of a linear operator, the Laasonen method for the "square root" of a matrix, the Jahn method for solving eigenvalue-eigenvector problems, and the Rapoport method for solving initial value problems of linear differential equation systems; also, the cubically convergent Kikuta method for solving eigenvalue problems. Thus, this book contains insufficient information about particular iterative processes to satisfy, by itself, the needs of the numerical analyst and practical equation-solver, who wishes to use techniques based on the principles of functional analysis. However, it is a very valuable and not too difficult introduction to an important new approach to equation-solving, which has so far been neglected too much and on which far too little research has been carried out.

Alan J. Mayne, Leeds, England

263:

COGAN, E. J.; NORMAN, R. Z.; AND THOMPSON, G. L. **Calculus of functions of one argument,** Prentice-Hall, 1960, 575 pps. $8.50.

This is another text book that is a result of the current ferment in the mathematics curriculum. While putting some new ideas in the standard course, it nevertheless keeps much traditional material, though it is organized somewhat differently. Numerical methods are neglected as is usual. *R. W. Hamming*, Murray Hill, N. J.

264:

SELFRIDGE, R. G.; AND MAXFIELD, J. E. **A table of the incomplete elliptic integral of the third kind,** Dover Publications, 1958, 14 + 805 pps. $7.50.

The table was computed and printed by an IBM 704. In the plan of computations, adequate checks for accuracy were included. The tables are correct to 6 places or more. Their value will be obvious to the many people who have needed them in the past.

On the other hand, now that the tables can be computed and printed accurately, there seems to be a trend, as exemplified by this book, of being careless about headings and labels, providing the little elegances that eliminate .399999 in place of .400, and providing accurate and clear prefaces. Perhaps we need a routine to do these jobs too!

R. W. Hamming, Murray Hill, N. J.

265:

● SANSONE, G. (Translated by A. H. Diamond) **Orthogonal functions,** Interscience Publishers, 1958, 12 + 411 pps. $11.00.

This is a translation of part of the third edition of Sansone's book on this subject (the chapters on "Approximation and Interpolation," and "The Stieltjes Integral" are omitted). The quality of the translation is excellent.

The book is an elegant presentation of the classical theory of orthogonal functions with the emphasis (136 pps.) devoted to the topic of Legendre polynominals. Laguerre and Hermite polynominals get one chapter (91 pps.) Fourier Series also gets careful attention (130 pps.) The style and selection of material are clearly chosen to please the classical mathematician, and little effort is made to communicate with the poor applied mathematician who wants to use the results. Nevertheless, the book is so clearly written that it promises to become a standard reference.

R. W. Hamming, Murray Hill, N. J.

266:

● DWIGHT, H. B., **Mathematical tables,** 2nd Ed., 1958, Dover Publications, Inc., 217 pps. $1.75.

These tables of the elementary and some higher mathematical functions are an enlargement of the first edition. They were apparently done on a typewriter and then photographed. Besides the elementary functions, the tables include: complete elliptic integrals of the 1st and 2nd kinds, Sine-, cosine-, and Exponential-integrals, binomial coefficients up through order 25, factorials and their logs to 250, various interpolation coefficients, surface zonal harmonics (through order 11) (Legendre polynomials) and their first derivatives (through order 8), Bernoulli and Euler numbers, the Gamma function, normal probability and the error integrals, the Bessel functions $J_0, \cdots, J_5, J_1', J_2', Y_0, Y_1, Y_2, Y_1', Y_2', I_0, I_1, I_2, I_3, I_4, K_0, K_1$, ber, ker, various roots, and, finally, the zeta function. References to more extensive tables are given. Generally the tables give 4 or 5 figures.

The format is well planned and, in spite of the typewriter characters, is easy to use. Frequently, differences are given. No errors were found in a superficial examination of the tables. *R. W. Hamming*, Murray Hill, N. J.

267:

● LANGER, R. E. (Editor) **Frontiers of numerical analysis,** University of Wisconsin Press, 1960, 11 + 132 pps. $3.50.

This report of a symposium contains eight papers prepared by experts and gives their ideas of the frontiers of their subjects. The subjects are: plasticity, nuclear pile design, satellite trajectory studies, aeroelasticity, operations research, problems in theoretical chemistry, magneto-

hydrodynamics, and meteorology. The papers are generally well written and understandable even by the non-specialist in the particular field.

R. W. Hamming, Murray Hill, N. J.

268:

KUNTZMANN, J. **Deux formules optimales du type de Runge-Kutta,** (Two optimum formulas of the Runge-Kutta type). *Chiffres* **2,** 1 (March 1959), 21–26. (French)

Two new formulas of the Runge-Kutta type are presented for a system of two differential equations of the first order $y' = f(y, z, t)$ and $z' = g(y, z, t)$. The formulas take into account the third and fourth order terms of the Taylor series respectively. In determining the coefficients of the formulas, not all possible higher order terms are compensated to zero, but rather a larger number of terms to almost zero. The symmetry of subintervals of the classic Runge-Kutta formulas had to be sacrificed. The subintervals of the third order formula are irrational numbers and of fourth order formula 2/5 and 3/5. The total computing effort with these formulas is basically the same as with the classic formulas for most differential equations. In cases where large portions of f and/or g depend on t alone, the classic formulas will require less computing because of subinterval symmetry. The error terms of the new formulas are given as combinations of higher order derivatives of f and g with respect to y, z and t. Three examples are presented for which the new formulas show greater accuracy than the classic Runge-Kutta and Gill formulas. *H. M. Sassenfeld*, Scottsdale, Ariz.

269:

SARAFYAN, DIRAN. **Divisionless computation of square roots through continued squaring.** *Commun. ACM* **3,** 5 (May 1960), 319–321.

Consideration of the recurrence relation $x_{i+1} = (x_i^2/m) + (a/m)$ gives rise to an interesting iterative method for the computation of $n^{\frac{1}{2}}$, given by $x_i = (x_{i-1}^2/m) + (a/m)$, $r_i = m - 2x_i$, where $a = 0.25(m^2 - n)$, $-\frac{1}{2}m < x_0 < \frac{1}{2}m$, and $r_i \to n^{\frac{1}{2}}$. The auxiliary x_i and a can be bypassed by recasting the equations in the form

$$r_{i+1} = r_0 - (m - r_i)^2/2m, \quad r_0 = (m^2 + n)/2m.$$

This process avoids division, since m can be any number whose reciprocal is convenient and stored in the machine, and the author shows that its convergence approaches that of a second-order process if m^2 is close to n. For example, if $n = 82$ and $m = 10$, r_2 is correct to four significant figures, and if $n = 440$ and $m = 20$, r_2 is correct to six figures. *Leslie Fox*, Oxford, England

270:

BAUER, FRIEDRICH L. **The *g*-algorithm.** *J. Soc. Indust. Appl. Math.* **8,** 1 (March 1960), 1–17.

According to the author, it is the purpose of this note to point out that the g-decomposition gives rise to a very general class of relation which is useful for a variety of numerical problems, especially those in a general algorithm, called "g-algorithm" in the following: It may be used in the same way as the gd-algorithm of Rutishauser for the iterative determination of the latent roots of a tridiagonal matrix including the determination of zeros of a polynomial. But while the limit behavior of the gd-algorithm is governed by the moduli of the roots, the g-algorithm allows a more flexible influencing of its convergence behavior. For example, it may be used directly for the separation of the roots. The second g-algorithm being a tool for Stieltjes summation of series and Stieltjes extrapolation of sequences, it links together other "rhombus algorithms" including the mathematically equivalent ϵ-algorithm of Wynn. This paper is devoted to the formulation of these relations and includes the following topics: g-decomposition, moments and determinantal representations, transformations of S-fractions using the g-decomposition, the g-rhombus rules, the g-algorithm, the progressive forth-and-back γ-algorithm, the second g-algorithm and related rhombus algorithm, continued fractions using η and ϵ, extended continued fractions, and a summary on numerical applications.

Lowell N. McClung, Silver Spring, Md.

271:

SHANKS, DANIEL. **A note on Gaussian twin primes.** *Math. Comput.* **14,** 70 (April 1960), 201–203.

The author calls Gaussian twin primes a pair of primes $a + bi$ and $a + 2 + bi$ in the field $\rho(i)$. He gives some examples of such numbers and considers the very special case $b = 1$. Using unproved conjectures of Hardy and Littlewood ("Partitio numerorum III: On the expression of a number as a sum of primes," *Acta Math.* **44** (1923), 1–70) and some computations, he obtains some conjectures for the number of such numbers. If these numbers should have any number-theoretical interest, then the natural problem would be to find the asymptotic number of such numbers not only for $b = 1$, but for any given value of b, or, better, the number of such pairs with $a^2 + b^2 \leqq n$ for every given n.

Alfred Brauer, Chapel Hill, N. C.

272:

ROBINSON, S. M.; AND STRUBLE, G. W. **A short method for measuring error in a least-squares power series.** *Comm. ACM* **3,** 6 (June 1960), 351.

Following standard statistical procedures, the authors derive an expression for the error in fitting a polynomial of arbitrary degree to a set of points by the least square procedure. This formula involves only summations that are used in the determination of the least square polynomial coefficients. It is suggested that this is a more efficient procedure for computer calculation than the common practice of evaluating the polynomial at each data point. *George C. Wallick*, Dallas, Tex.

SCIENTIFIC AND ENGINEERING APPLICATIONS

273:

KOSTENKO, M. P. **An intensive programme of investigations in electromechanics.** *LLU Translations Bulletin* **2,** (February 1960) 116–128.

This article (*a translation from the original Russian*) is devoted mostly to outlining plans to be executed and problems to be solved. It starts with a statement that a grandiose program for the development of power supply systems for 1959–1965 has been adopted by the decision of the 21st Congress of the Communist Party of the Soviet Union. Briefly, the plan is to double the generating capacity and to tie all the systems into a single one for the whole Union. The program of investigations, to be carried out by the Institute of Electromechanics of the Academy of Sciences of the USSR, are related, directly or indirectly, to the power system enlargement. Some of the problems to be tackled include: electrical and mechanical design studies of turbogenerators; power system studies; high-power compressor motors without flywheels; static excitation systems; liquid-cooling of machines; a-c and d-c high-power transmission systems; protective relays and devices, including semi-conductors using the Hall effect; telecontrol and telemechanization; raising efficiency of high-frequency communication channels, microwave systems; complex computer control of industrial processes, including milling machines and other machine tools; drive systems for steel-mill applications; photoelectric copying of profiles, too complex for mathematical analysis and programming; improvements in electric welding machines and automation techniques; automatic tracking of a 100″ telescope; railway electrification, both with single-phase power, and diesel electric power.

C. G. Veinott, Cleveland, Ohio

274:

MERRITT, FREDRICK S. **ENR special report on computers.** *Eng. News-Record* **164** (April 14, 1960), 39–42, 44–45, 48, 51–52, 54, 59, 61–63.

This summary of some basic facts about computers is oriented toward persons with an engineering background. The titles of the individual articles are "What You Should Know About Computers"; "Second Generation Computers Are Smarter and More Sophisticated"; "Decisions: Buy? Rent? How to Organize for Profitable Operation"; "How to Program a Digital Computer"; and "How to Select the Right Computer." The latter includes a summary of the major characteristics of some of the smaller computers on the market. *Ned Chapin*, Menlo Park, Calif.

275:

CURIEN, H.; AND TOURNARIE, M. **Réglage précis de l'orientation d'un cristal monté sur une tête goniométrique** (Exact determination of the orientation of a crystal mounted on a goniometer). *Chiffres* **2,** 1 (March 1959), 27–33. (French)

Trigonometric calculus required to give the orientation of a crystal with good accuracy, is presented in order to show the use of an E101 computer.
(*Author's Summary*) *Mary McCammon*, State College, Pa.

276:

● SMITH, KENNETH. **A general program for calculating cross-sections in wave mechanics.** Argonne National Laboratory (Report), Lemont, Illinois, 1960, 16 pp.

Five pages of this report consist of a definition of terms and a sketch of the well-known relations between total cross sections and the amplitudes and phase shifts of the partial waves into which the total wave function can be decomposed. The report formulates in matrix algebra a Fortran program of about 75 statements that will produce these cross sections *if* given all the amplitudes and phase shifts of the partial waves, which the user must produce by integrating the physical equations. An example (position scattering by atomic hydrogen) of the output of this program is given. *J. N. Snyder*, Urbana, Ill.

277:

BISDORF, W.; AND SPIEWOK, G. **Rechenprogramm für IBM 650 zur berechnung von wasserrohr-leitungsnetzen** (Routine for IBM 650 for water pipe network analysis). *Electronische Rechenanlagen*, **1,** 1 (February 1960), 13–15. (German)

A program for an IBM650 is described which computes the flow of water in a network of pipes, given the configuration, lengths, diameters and friction coefficients of the pipes. It is intended for use in mining, where water in certain quantities and at certain pressures must be supplied, e.g. for fire fighting. But the same program, with only minor modification, should be suitable for a wide class of problems of solving equations on graphs, in the frequent case where the unknowns are associated with the edges of a graph while there is a set of equations associated with the vertices and another set with the cycles formed by edges of the graph. *Franz L. Alt*, Washington, D. C.

278:

BARRON, D. W.; AND SWINNERTON-DYER, H. P. F. **Solution of simultaneous linear equations using a magnetic-tape store.** *Comput. J.* **3,** 1 (April 1960), 28–33.

The use of the Gauss elimination method of solving simultaneous linear equations where internal store is limited and external magnetic tapes are used for working storage is considered. Problems of scaling and checking are included. An efficient subroutine for this method using EDSAC 2 is outlined. Computer time of 7 minutes for 100

equations with 1 right-hand side was observed and a general formula for determining computer time for solution is given. Although equation storage by rows is used the possible advantages of column storage are also considered. A two-page description of EDSAC 2 and its magnetic-tape system is appended. *E. M. McCormick*, Washington, D. C.

STATISTICS

279:

ROBERTSON, W. H. **Programming Fisher's exact method of comparing two percentages.** *Technometrics* **2,** 1 (February 1960), 103–107.

The method of the title requires the evaluation of a quotient of products of factorials, presumably for large numbers. By elementary operations, the author reduces this to a form more efficient for computation, and gives a detailed flow chart for a program to evaluate the improved form. Two quotations from the paper are worth considering in juxtaposition. From the first page:

"When two percentages are to be compared to see if a significant difference exists, there are several statistical methods for making the comparison. One method which is not used to its full advantage is Fisher's Exact Method (1). Approximate methods are more frequently used because the computations required by Fisher's method are generally time-consuming, even when a desk calculator is available.

"With the advent of digital computers, Fisher's method should be employed more often. In fact, now that small computers are becoming generally available, the determination of exact probability statements through the use of computers is a concept that the entire statistical world should be considering."

From the last page:

"Since rounding error can be a consideration (due to the large number of repeated division-multiplication operations) scaling may be a problem if the program is written in fixed point. In floating point, rounding error should not effect the results since the final probability is seldom required beyond three decimal points."

H. G. Rice, Santa Monica, Calif.

TECHNOLOGICAL EFFECTS AND CYBERNETICS

280:

HARRINGTON, JOSEPH, JR. **A look into tomorrow.** *Automation* **7,** 5 (May 1960), 66–70.

This after-dinner speech by a very literate professional engineer contains a summary discussion of the economics of wage rates, employment, and productivity, as well as a look at two important problems for the future of automation: (1) capital formation, and (2) education.

Since this is generally a persuasive article, two or three matters open to question should be mentioned. Mr. Harrington finds it "anomalous that in an era of rapidly expanding population we have a decreasing number of productive man-hours per capita . . .". Since a population can expand only by means of a decreasing death rate or an increasing birth rate, or both, how can it be anomalous that the ratio of youngsters and oldsters to middle-aged workers will increase (unless, like Victor Borge, people are born at the age of five)?

In discussing the requirements of capital formation for automation, the author disposes of Professor Wiener's famous prediction that all would be automated in 10(?) years. Professor Brozen has estimated that approximately one-half trillion dollars would be required to bring all U. S. industry up to the level of today's technology. This figure is divided by the present rate of capital formation, $8 billion per year, to achieve an estimate of 60 years required for the job. But "by that time, technology would have moved far beyond where it is today". This latter is a valid prediction, but perhaps its import is misinterpreted. Rather than extending the time required to automate fully, this factor of technological advance should shorten it by making the job cheaper to accomplish. What must be done today in costly fashion by crude methods and techniques, will be done tomorrow by less costly ones.

Neither space nor the reviewer's knowledge allow a full discussion of the educational problems surrounding automation. The matter of technological displacement and retraining is underemphasized, especially the problems of the older worker. The author does agree, however, with the majority of observers that a key problem for tomorrow is the under-education of young people in this country, today. *Bruse Moncreiff*, Katonah, N. Y.

THEORY OF AUTOMATA AND COMPUTERS

281:

TURING, SARA. **Alan M. Turing.** Heffer, Cambridge, England, 1959, 14 + 157 pp., 21 s.

"The aim of this book is to trace from early days the development of a mathematician and scientist of great originality and to record details from which a selection may be made by a future biographer". So writes his mother in the preface, and, considering the difficulty of her task, it is well done. Turing is, of course, a very interesting, important name in the history of computing machines. His life and some of his work is traced in fair detail, though the man himself eludes me amid the details she chooses to give of his life. To Americans of this generation, his early life spent as it was in various places in England while his parents were in India, seems most unfortunate.

While the official verdict of his unfortunate death was suicide, she presents a fair case for the verdict of accidental (careless) death.

To those interested in Turing Machines, the book will be most interesting. *R. W. Hamming*, Murray Hill, N. J.